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CITY FIRE LIMITS

By Albert Blauvelt

This is not a set talk, and if any one can enliven the occasion by any question or remarks the speaker will be glad to have him do so.

A water works is of course an essential of modern fire protection, yet it is but one of twelve general factors or departments which go to make up the fire protection of a large city as a whole. One also of the twelve parts or factors of modern city fire protection is the "fire limits" or central district in which frame buildings are prohibited. This evening's talk is to attempt to show that our cities in general are more in need of higher requirements as to the fire limits, than of high pressure systems or larger water works.

The public usually gets its idea of the presence of the water supply by seeing fire department hose streams. At time of disastrous fire the unfortunate practical fact is that such a fire is usually so large that it becomes a dry fire, one which does not receive any water at its heart, or core, and to that extent the water works is useless. Any one who is in the least accustomed to examining fire ruins can very readily tell whether water reached the heart or center of the fire, or whether the fire remained dry, and it is an unfortunate fact that the important fires are ofttimes dry at the center or precisely where water would do most good were it possible to apply it. Another still more unfortunate fact is that the bigger a fire, the more certain it is to be a fire which may be termed a dry fire. That is peculiarly a characteristic of all very heavy city fires after the hot blast has developed.

The conflagration of the city of Chicago in 1871 was such, and typical of the most destructive type of conflagration, and is especially interesting in connection with the particular viewpoint that we will come to later.

When Chicago had its great fire the city then had but about 350,000 inhabitants. While that fire originated at a point which is now inside the fire limits, yet the fire of 1871 was typical in its day as an outskirts fire and from that outlying place of origin burned into and through the city proper.

Another of the older of the modern city fires, that at Boston in 1872, was typical of another type of conflagration which begins in the heart of the city, and in the teeth of the fire department, then goes on and develops into the conflagration form.

Toronto has had several severe fires mostly starting in some cheap district where special fire protection would be a financial impossibility.

The Baltimore conflagration was carefully analyzed by men who had studied earlier conflagrations, and is more accurately mapped and platted than any other conflagration. It began in the face of the fire department, in the heart of the city, with no high wind, no severe weather, everything favorable for fire department operations, with lavish supply from the water department, and in broad early daylight. The wind during the whole period of that fire was very moderate as shown by the United States Weather Bureau, and yet, if that wind had not shifted toward the bay or harbor there would have been little left of Baltimore. These typical examples of very heavy and disastrous city fires, some of which started in town and some out of town, were dry fires each and all.

We are often indebted to our newspaper friends for some acute observations, for instance, the *Chicago Tribune*, with reference to the Baltimore fire, has this to say:

> It was a great fire, and a peculiar one, in that it was a dry fire, that is to say, not a quart of water reached the central portion of the conflagration. The temperature of the fire that beat against and into the skyscrapers was probably 2000°. It was a terrible assault. The unprotected window openings afforded easy ingress to the fire, and plenty of woodwork was found on the inside for the flames to feed upon.

This *Tribune* report was absolutely accurate and we must also remember that the Baltimore fire was no more dry than preceding conflagrations all have been and to a certain extent must ever be.

Another thing that is misleading, although it is extremely natural, but it is unfortunate, is that we habitually speak of the burning of buildings. Now buildings do not comprise a city. A city is composed of contents, and the buildings are merely accessory to the contents. It is the contents that ignite, it is the contents that represent the bulk of values and fuel. We may say that the spectacle or phenomenon of a conflagration should be looked upon not as one building burning another, but as the contents of one building communicating the fire to contents of the next building. The contents are the important things, both as to the hazard, the quantity or bulk of combustible material, and the value.

At Baltimore the steel frames that stood after the fire were simply rough shells of what were formerly buildings and their contents. Some people imagine that those frames represented a considerable salvage. Unfortunately they represented very little salvage as compared to original values plus tenants' property. The people who occupy office buildings have a great deal more property as tenants than they themselves know, anywhere from $50,000 to $150,000 per floor is not at all uncommon. The burning at Baltimore was not so much from building to building as from contents to contents; and the prime cause of the destruction of the so-called fireproof buildings was not the general fire but the contents of said buildings, however slight those contents might appear.

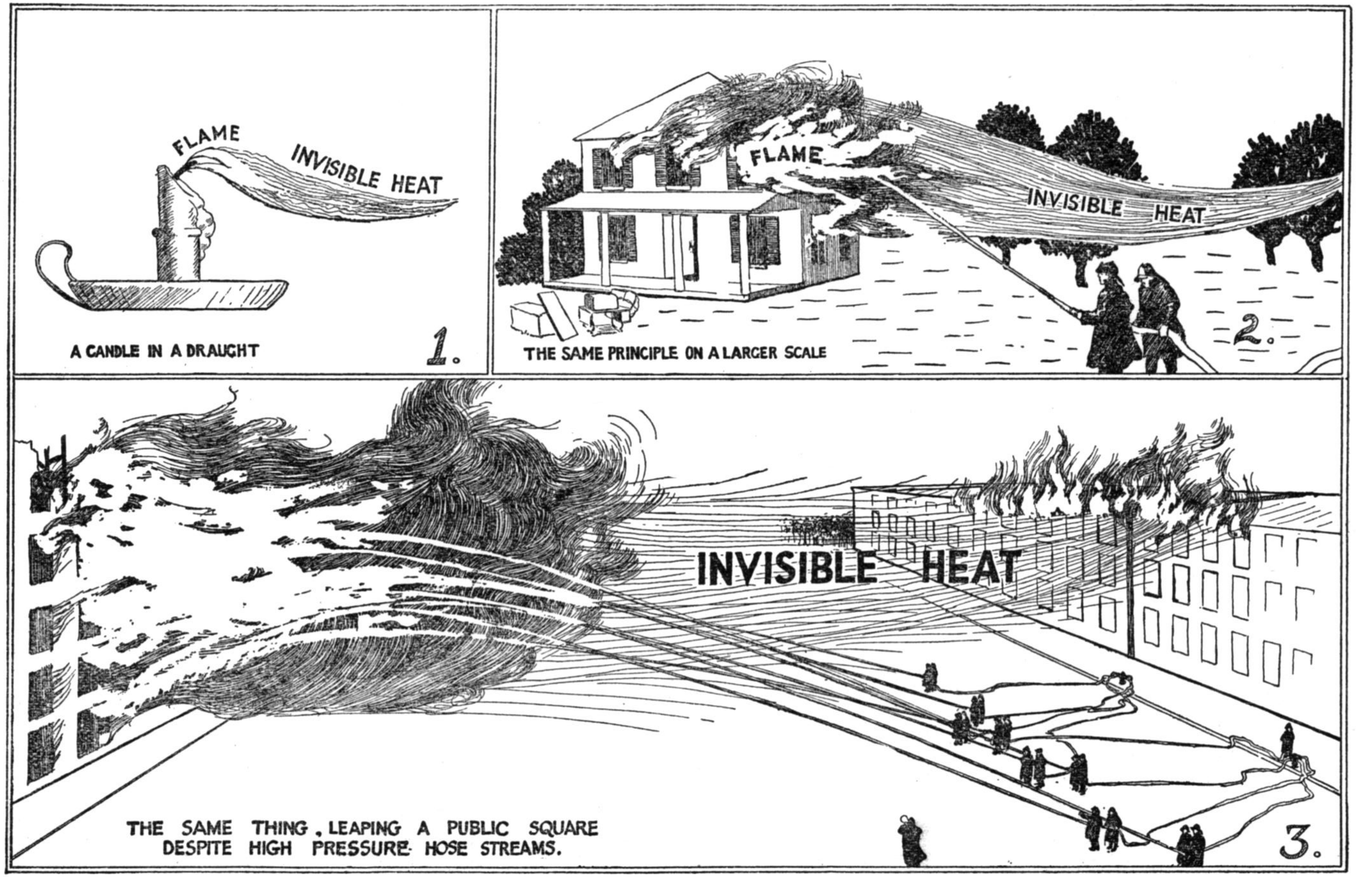
When you use steam boilers, you expect a pound of fuel to evaporate about ten pounds of water. When you burn a pound of fuel in a foundry cupola you expect it to reduce far more than its own weight of metal, and the same rule that applies to the ordinary furnace equally applies to the destructive or reducing power of fuel inside a building. The Continental Trust Company Building at Baltimore is a case in point. This was a bank underneath an exclusive office building. The contents were simply ordinary desks and furniture, trim, office files and so on, which one would hardly think of as sufficient fuel to reduce all to a gaunt skeleton, yet the destruction was brought about mainly from the mere contents.

It may seem unreasonable to state that a fire can be dry with the fire department at work, and considering that Baltimore had lavish water works. That is a perfectly pertinent question respecting all heavy city fires, with the fire department in operation, and the water works also in full operation, and, if so, why have either? The answer is that had it not been for the water works, and had it not been for the fire department, the fire at Baltimore would have reached enormously greater dimensions than it did. The fire departments were not able to do anything at all in the direct central path of the fire, but local and visiting firemen did an immense amount of good in hemming in the edges and so preventing the fire from cutting a much wider swath, and also did an immense service in checking fire from fire brands which were thrown far in advance of the main fire.

Why it is that these heavy fires get no water where most needed is something which many of you already appreciate yet it may not be amiss to try an explanation of it. The principle is a simple one. Let anyone hold the hand over the flame of a candle. You will find that the heat is not bearable to the hand even at a considerable distance when held directly over the flame. It is also noticeable that there is a strong upward draft although the air in the room may be quiet. In any fire the expansion of gases due to the combustion speeds up the draft and we can calculate the velocity of the draught of a large fire from the manner in which it is able to throw firebrands. In a rough way it is a fair statement that the acceleration of draft local to, and immediately proceeding from, a fire is about four to one. That is to say, a 10-mile breeze fanning a fire is accelerated into about a 40-mile wind as it issues from that fire; and a 25-mile wind supplying oxygen to a great fire will accelerate up to approximately 100 miles an hour as it comes out of the fire. All this is consistent with the action of a large fire as to its throwing heavy firebrands to great heights and long distances. It does not take a very large fire to produce a dangerous hot blast and if the wind is sufficient to carry this hot blast over into a fairly horizontal position, the firemen are then held at a distance and cannot endure the hot blast and must retreat. The rear or trail of the fire necessarily is a bed or trail of burning embers. The fire department cannot work on the front or rear of a great fire simply because the hot blast occupies the front and an area of burning ruins occupies the rear.

Illustration No. 1 is intended to show the action of the hot blast as if it were visible. Any one who will take a slow speed fan and set a candle in front of it, will find it impossible to hold the hand close to that candle sidewise as is natural because the heat is then carried to the side. A house fire in a wind acts the same except, as is illustrated, it is on a larger scale. In small fires like a single house a hose stream is long enough to overreach the hot blast. But when the fire is a large one and fanned by a brisk wind, as shown in the main or lower figure of the illustration, it makes no difference how powerful the hose stream is, no hose stream can overreach the length nor the diagonal width of the hot blast and, therefore, the core or heart of the fire remains dry.

At Baltimore the wind did not at any time exceed twenty-five miles an hour; but there were times in certain streets when firemen could not stand within several hundred feet of the front of that fire. The hose streams were absolutely ridiculous and such is the situation in all large fires in a wind; the hot blast makes it impossible for



A CANDLE IN A DRAUGHT

THE SAME PRINCIPLE ON A LARGER SCALE

THE SAME THING, LEAPING A PUBLIC SQUARE
DESPITE HIGH PRESSURE HOSE STREAMS.

Action of Hot Blasts

the firemen to hold a front stand to head off the fire. Such fires have never been controlled by any water works or any fire department, and from the nature of the case they burn a wide swath through a city unless the wind dies down. The Chicago fire simply burned on through into the lake. At Baltimore the fire burned out to the harbor. At Lynn, Massachusetts, it burned out to the Atlantic Ocean.

Coming to the question as to whether these hot blast fires can be prevented, or whether we must expect to have more cities wrecked, it seems certain that there is no complete remedy and yet there is at least a seven-eighths remedy. In the outskirts of cities no human ingenuity can suggest a remedy that is within financial bounds. A fire may come from this, that, or the other cause on the outskirts where cheap property cannot bear the cost of any effective anti-conflagration treatment. There is, however, a great deal of ground for believing that the very costly central districts of a city can be protected in spite of a conflagration that comes in from the outskirts, and that it is also possible to so protect the central or costly district that a conflagration cannot arise within said district. Experience has shown that a number of heavy city fires after having gone wholly out of control have later been gotten under control because of reaching a location presenting the resistance of shuttered alleys. A thoroughly shuttered alley exercises a great slowing-up effect. Any fire on reaching a full set of shutters or wired glass is checked considerably and is checked further in crossing the alley and checked again severely by the second set of shutters or wired glass. This is not to say any two sets of window stops will stop any such heavy fire as at Baltimore; but the point is that merely a plain alley thoroughly stopped on two sides has checked some fires which were wholly beyond fire department control and points to general use of protected windows. Many fire protection engineers believe that to protect the window openings of the central district of a city would alone be sufficient as an anti-conflagration treatment. The thing needful is to prevent fire inside a building from coming out of that building, and thus keep the fire from reaching the contents of the adjacent building. Fires are fed by the interior contents of buildings. If fire originates in a building or enters a building on the windward side the thing essential is to prevent the fire escaping and spreading from out the down wind or lee side. Obviously a street main, however large, is not able to help us in this particular, after a hot blast has developed and the firemen are unable to hold ground.

Now, there have been some very interesting experiences that prove that this fatal communication from contents to contents does not necessarily have to be guarded against by fire walls nor by shutters or wired glass. It has been found that spread of fire from contents to contents can be checked by a spray as from automatic sprinklers. In fact, a dense spray seems more effective than a fire wall provided the spray is deep, perhaps if need be, as deep as the building.

The city of Boston in 1893 had a fire which was absolutely beyond the control of the fire department until checked by a sprinklered building, known as the Brown-Durell Building, a very large brick building which stood directly in the path of the brunt of the hot blast. The heat opened a large number of sprinklers and the hot blast was sufficiently absorbed by the volume of spray and that hot blast did not emerge on the lee side of the building and the town was saved. Another sprinklered building, the Kilgour, is also credited by good judges as having been of similar service in Toronto in 1904. The spray must be deep, must be backed by a large water supply and must be inside, not on the outside, of the building, because outside spray blows out of place and away in a wind such as always exists at a time of conflagration.

As earlier stated, cheap property cannot stand the expense of preparation to positively stop the spread and run of fire, but it is commercial and also possible to prepare a costly congested district to do so and also to stand the brunt of any fire from a cheap district. This means the establishment of special fire limits inside of the ordinary fire limits, using waterless sprinklers and fire department engine water for some buildings, protected windows on other buildings, automatic water supply sprinklers in other buildings, etc., always keeping in mind the principle of intercepting the communication of fire from contents to contents. Such protective features because of cost would be mostly limited to a four-story or higher district or to city values aggregating not less than $100,000,000 per square mile.

The fire that attacked the Brown-Durell Building was burning up values at the rate of $800,000,000 per square mile, and in such a district an inner fire limits would be cheap in relation to the risk and the values at stake. A city carries about nine-tenths of its values upon about one-tenth of its area. Experience with those few very heavy city fires that have been checked has shown very conclusively that they cannot be stopped at any exact dead line but can be stopped within one or at the most two blocks as shown on the illustration.

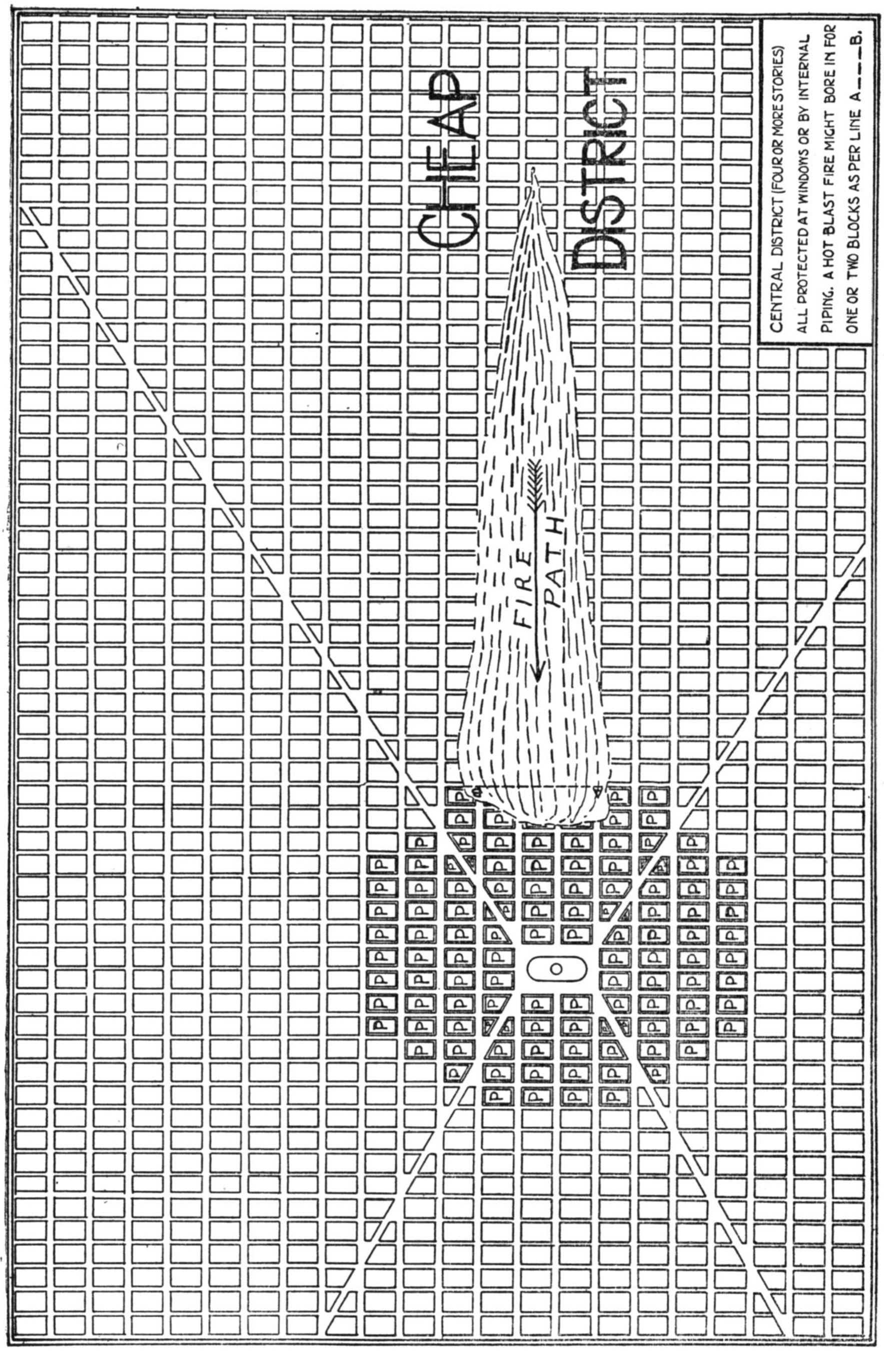
Because firemen cannot stand against a hot blast longer than the length of a hose stream, we cannot, therefore, through firemen or through water works expect to make safe our large city values. But we can establish an inner fire limit wherein the hot blast would either be deflected by successive barriers or be absorbed by spray, or partly deflected and partly absorbed, so that the fire shall subside sufficiently to permit the normal operation of the fire department and be within the capacity of the average water works.

The second illustration shows an inner fire limit (the group of blocks marked "P"), indicating a district in which every building is piped for sprinklers or, if not, has protected windows on all sides.

It seems to the speaker that our big cities can spend money to far better advantage to deflect or absorb hot blast fires from driving through their central districts than for heavier water mains or larger fire departments. It makes no difference what pressure may be used nor what water is provided as against the fact that no water works nor fire department can cope with a well developed hot blast. Better to agitate for checking the hot blast rather than expect the impossible from the fire department or the water works.

An inner fire limit as described is not likely to be put into practice at any very early date; the difficulty of apportioning the expense is very great. It involves the necessity for coercing the property owners as to their individual properties, and there are many such reasons which probably will for a very long time prevent our large cities from establishing inner fire limits to resist attack of a hot blast from a cheap district; and yet conviction seems unescapable that eventually something of that kind must be done. Our cities are growing and the values are piling up. We have never had any true hot blast checked by any fire department or water department, and we cannot have. We also have never had a really big fire yet as compared to the chances in our great cities. These conflagrations lie in wait for our big cities, and ordinary arithmetic indicates that some of these fine mornings we will wake up and find some city of a million inhabitants wiped out and with it a realization will come that a very small percentage of such an appalling loss if applied to central protection would have protected all of the larger cities and also paid its way on a yearly fire basis.

In this problem of city fire protection the real need is on the part of the citizens of the town and the individual building owners to rearrange the city plan proper.



CENTRAL DISTRICT (FOUR OR MORE STORIES) ALL PROTECTED AT WINDOWS OR BY INTERNAL PIPING. A HOT BLAST FIRE MIGHT BORE IN FOR ONE OR TWO BLOCKS AS PER LINE A——B.

DISCUSSION

A Member: How about water curtains; are they effectual in stopping fires?

Mr. Blauvelt: Water curtains are not of very much good except for a moderate fire. When there is a constant heavy fire blast bearing on a building a depth of spray about as deep as from here to the other side of the hall is needed and this can only be had in sprinklered buildings with heavy water supply.

A Member: About the Salem fire; was that a fire which came in from the cheap district?

Mr. Blauvelt: Yes, sir; started out in the thinly settled district and burned down into the town. A city like Salem, however, could not be protected by any engineering short of reconstruction. What has been said must apply to fire limits inside of what is now recognized as modern fire limits. An inner fire limit as discussed is applicable only inside of what are now known as "fire limit districts" in which shingle roofs and frame buildings have been eliminated. Salem was a town of much frame and shingle roofs, and there are no engineering plans that might meet that situation.